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ScienceDirect

Tanta Dental Journal 12 (2015) 132–139

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Evaluation of the antibacterial efficacy of different bioactive lining and pulp capping agents

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Received 11 January 2015; revised 13 April 2015; accepted 20 April 2015
Available online 23 May 2015

Abstract

Aim: To evaluate the antibacterial potential of dental cements on the growth of the colonies of *Streptococcus mutans*.
Materials & methods: Ten Discs were prepared from three types of bioactive materials; light cure calcium hydroxide, light cure resin modified glass ionomer, and Biodentine. Bacterial Strain *S. mutans* was suspended in Tryptone Soy Broth (TS) medium and incubated for 18 h. Agar diffusion test was used to evaluate the antibacterial activity by measuring the gauge of inhibition zone around the discs. Statistical analysis was performed by using one-way Anova test and differences were considered significant at the 95% confidence level ($P < 0.05$).
Results: A significant difference of antibacterial characteristics between groups at $p \leq 0.001$. Biodentin had the largest inhibition zone (15.14 ± 0.34), followed by Resin modified glass ionomer (11.22 ± 0.13). Light cured Calcium hydroxide showed the smallest inhibition zone (9.15 ± 0.3).
Conclusion: While Biodentin showed the strongest antibacterial properties, the VLC bioactive glass ionomer and calcium hydroxide cements are also effective as standard pulp-capping products in inhibiting the growth of *S. mutans* organism commonly found at the base of a cavity preparation.

Keywords: Bioactive dental cements; Streptococcus mutans; Agar diffusion test; Inhibition zone

1. Introduction

Antibacterial activity of materials that can be used as both dental luting cements and pulp capping materials, during and after setting, assumes clinical relevance, as this property may help in the elimination or reduction of bacteria that have remained viable on walls of the preparation or bacteria that may gain access to the cavity through marginal gaps [1]. In spite of the operator's conscious effort to remove infected

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Peer review under the responsibility of the Faculty of Dentistry, Tanta University.
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http://dx.doi.org/10.1016/j.tdj.2015.04.003
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Table 1
: Materials' specifications, composition, manufacturers and batch number.

Materials	Specification	Composition	Manufacturer	Batch no
Group A Urbical LC	Light cured calcium hydroxide	Mixture of different dimethacrylates, calcium hydroxide, pigments, initiators, silicate fillers	Promedica Dental Material GmbH. Domagkstr. 31. D − 24537 Neumünster Germany.	1332073
GroupB Harvard Ionoresin fill	Light cure Resin modified glass ionomer	Mixture of barium-fluoro-alumino Silicateglass powder, pigments, initiators	Harvard Dental International GmbH Margaretenstr. 2−415366 Hoppegarten, Germany	4961301
Group C Biodentine	Biodentine	**Powder**: tricalcium silicate, dicalciumsilicate, calcium carbonate and oxide filler, iron oxide shade, and zirconium oxide. **Liquid**: calcium chloride as an accelerator and a hydrosoluble polymer that serves as a water reducing agent.	Biodentine™ (Septodont, St. MaurdesFossιs, France)	B02282

dentin during cavity preparation, bacteria are frequently, unintentionally left behind in the dentinal tubules overlying the pulp chamber. Bacteria have been cultured from dentin more than a year after having been sealed under restorations [2].

Carious lesions were described by being formed of two layers; an outer heavily infected layer that should be removed during cavity preparation and an inner affected layer that would be retained and treated with a therapeutic lining or base of calcium hydroxide, glass-ionomer or a similar material. Secondary caries is readily formed in restoration margins or gaps where plaque containing various bacteria adheres. Among the bacterial species present in these biofilms, *Streptococcus mutans* is recognized as the one most frequently involved in caries formation [3−5]. Colonization of bacteria often occurs at secluded locations in shortage of oxygen, mechanical disturbance and consequently bactericidal properties of dental cements are of particular importance as a mean by which bacteria can be inhibited in these sites. Pulp capping is a technique designed to preserve the vitality of a potentially infected pulp. Both direct and indirect pulp capping are only successful if the pulpal infection is very mild [6,7].

Calcium hydroxide $Ca\ (OH)_2$ has been standard material for maintaining the vitality of pulp with the advantages of the ability to stimulate tertiary dentin formation. The advent and development of technologies supported the approach of Minimal Intervention philosophy that shifted towards the biological non-operative management of teeth. The high pH $Ca(OH)_2$ provides bactericidal activity, and is associated with increased dentin bridge formation when used as pulp capping material. However, this material is compromised by unstable physical properties which allow particles of capping material including dentin chips to migrate into pulp tissue and complicate pulp healing [8−12].

Glass-ionomer cements are characterized by acid-base setting reaction, chemical bonding to enamel and dentine, fluoride release, biocompatibility with the major advantages of their potential cariostatic effect. Resin modified glass-ionomer (RMGI) is widely used also for temporary indirect pulp capping. Among the advantages is the anti-cariogenic activity, ability to remineralize dentin and stable physical characteristics, with low fracture resistance. Some advantages of RMGI may make it an ideal pulp capping material [13−15].

Biodentine known as "dentine in a capsule" also called as smart dentin replacement, a biocompatible and bioactive dentin substitute which overcomes the disadvantages of Calcium hydroxide of poor bonding to dentin and material resorption. Biodentine was developed as a new class of dental material which could conciliate high mechanical properties with excellent biocompatibility, as well as a bioactive behavior. A new calcium-silicate based formulation, which is suitable as a dentine replacement material whenever original dentine is damaged [16].

Biodentine allows a dentist to achieve biomimetic mineralization within the depths of a carious cavity, as it has the potential to revolutionize the management of